IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Kiruba Sivasubramaniam et al.	§	Group Art Unit:	2834
Serial No.: 10/766,459	§	Examiner:	Lam, Thanh
Filed: January 27, 2004	§		
For: AC WINDING WITH INTEGRATED COOLING SYSTEM AND METHOD FOR MAKING THE SAME	§	Atty. Docket:	136236-1/YOD GERD:0505

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June 19, 2006 — Lynda Howell
Date — Lynda Howell

APPEAL BRIEF PURSUANT TO 37 C.F.R. §§ 41.31 AND 41.37

This Appeal Brief is being filed in furtherance to the Notice of Appeal mailed on March 13, 2006, and received by the Patent Office on March 20, 2006.

The Commissioner is authorized to charge the requisite fee of $500.00, and any additional fees which may be necessary to advance prosecution of the present application, to Account No. 07-0868, Order No. 136236/YOD (GERD:0505).

Appellants hereby request a one (1) month extension in the statutory period for submission of the Appeal Brief, from May 20, 2006 to June 20, 2006, in accordance with 37 C.F.R. § 1.136. The Commissioner is authorized to charge the requisite fee of $120.00, and any other fee that may be required, to Deposit Account No. 07-0868, Order No. 136236/YOD (GERD:0505).

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1. **REAL PARTY IN INTEREST**

The real party in interest is General Electric Company, the Assignee of the above-referenced application by virtue of the Assignment to General Electric Company by James Alexander, Evangelos Trifon Laskaris, Manoj Ramprasad Shah, Kiruba Sivasubramaniam, recorded at reel 014944, frame 0825, and dated January 27, 2004. Accordingly, General Electric Company, as the parent company of the Assignee of the above-referenced application, will be directly affected by the Board's decision in the pending appeal.

2. **RELATED APPEALS AND INTERFERENCES**

Appellants are unaware of any other appeals or interferences related to this Appeal. The undersigned is Appellants' legal representative in this Appeal.

3. **STATUS OF CLAIMS**

Claims 1-20 are currently pending, are currently under final rejection and, thus, are the subject of this Appeal. Claims 21-24 produced in Appendix stand withdrawn.

4. **STATUS OF AMENDMENTS**

As the instant claims have not been amended at any time, there are no outstanding amendments to be considered by the Board.

5. **SUMMARY OF CLAIMED SUBJECT MATTER**

The present invention relates generally to the field to AC windings of electric machines, and particularly, to cooling systems integrated with AC windings of high frequency electrical machines, and further, to a method of manufacture for making the AC windings. *See* Application at page 1, paragraph [0001].

The Application contains three independent claims, namely, claims 1, 12 and 13, all of which are the subject of this Appeal. The subject matter of these claims is summarized below.

With regard to the aspect of the invention set forth in independent claim 1, discussions of the recited features of claim 1 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment in accordance with the present invention includes a winding (*e.g.*, 32) of an electric machine (*e.g.*, 10) including a series of serially connected AC bars (*e.g.*, 200). S*ee, e.g., id.,* paragraph [0020] and paragraph [0021] and FIG. 1. Each AC bar includes a series of serially connected turns (*e.g.*, 211-218) formed by litz wire having a plurality of strands; and a cooling tube (*e.g.*, 242). S*ee, e.g., id.,* paragraph [0023] and paragraph [0024], FIG. 2. The individual strands (*e.g.*, 230) of the plurality of strands are respectively positioned substantially adjacent to the cooling tube (*e.g.*, 242) at a transfer point for providing heat transfer from the respective individual strands to the cooling tube. S*ee, e.g., id.,* paragraph [0027] and FIG. 3.

With regard to the aspect of the invention set forth in independent claim 12, discussions of the recited features of claim 12 can be found at least in the below cited locations of the specification and drawings. By way of example, an embodiment of the present invention includes an electric machine (*e.g.*, 10) having an AC winding (*e.g.*, 32) that includes a series of serially connected AC bars (*e.g.*, 200). Each AC bar comprises a series of serially connected turns (*e.g.*, 211-218) formed by litz wire having a plurality of strands; and a cooling tube (*e.g.*, 242). S*ee, e.g., id.,* paragraph [0023] and paragraph [0024], FIG. 2. The individual strands (*e.g.*, 230) of the plurality of strands are respectively positioned substantially adjacent to the cooling tube (*e.g.*, 242) at a transfer point for providing heat transfer from the respective individual strands to the cooling tube. S*ee, e.g., id.,* paragraph [0027] and FIG. 3.

With regard to the aspect of the invention set forth in independent claim 13, discussions of the recited features of claim 13 can be found at least in the below cited locations of the specification and drawings. Another embodiment of the present invention includes a winding (*e.g.*, 32) of an electric machine (*e.g.*, 10). The winding

includes a series of serially connected AC bars (*e.g.*, 200). *See, e.g., id.,* paragraph [0020] and paragraph [0021] and FIG. 1. Each AC bar includes a series of serially connected turns (*e.g.*, 211-218) including a conductor; a cooling tube (*e.g.* 242) having a cooling medium flowing through a conduit having a thermally conductive surface. *See, e.g., id.,* paragraph [0023], paragraph [0024], FIG. 2 and paragraph [0031]. The AC bar also includes a phase to ground insulation (*e.g.*, 308) for providing electrical phase to ground insulation for the AC bar, where the phase to ground insulation surrounds the series of serially connected turns and the cooling tube (*e.g.*, 242). Also the respective turns of the series of turns contact the cooling tube for transferring heat from the respective turns to the cooling tube, where at each point of contact the phase to ground insulation does not intervene between the conductive surface of the cooling tube and a respective conductor. *See, e.g., id.,* paragraph [0035] and FIG. 4.

A benefit of the invention, as recited in these claims, is the utility of such armature windings for high frequency electric machines, such as high speed and/or high power density electric machines, particularly machines operating at frequencies significantly higher than 60 Hz. These might include motors or generators used in commercial or military applications, and in applications requiring light weight and compact electric machines, such as aircraft applications. *See, e.g., id.,* paragraph [0034].

This is a clear difference and distinction from the prior art, as discussed below.

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Sole Ground of Rejection for Review on Appeal:

Appellants respectfully urge the Board to review and reverse the Examiner's sole ground of rejection in which the Examiner rejected claims 1-20 under 35 U.S.C. § 103(a) as being unpatentable over Emery (U.S. Patent 6,624,547, hereinafter "Emery") in view of Clifton et al. (U.S. Patent 5,731,645, hereinafter "Clifton").

7. ARGUMENT

As discussed in detail below, the Examiner has improperly rejected the pending claims. Further, the Examiner has misapplied long-standing and binding legal precedents and principles in rejecting the claims under Section 103. Accordingly, Appellants respectfully request full and favorable consideration by the Board, as Appellants strongly believe that claims 1-20 are currently in condition for allowance.

A. Sole Ground of Rejection:

The Examiner rejected claims 1-20 under 35 U.S.C. § 103(a) as being unpatentable over Emery the in view of Clifton. While the Examiner rejected each of independent claims 1, 12, and 13 on the basis of Emery and Clifton, each of these independent claims will be discussed separately below.

1. Judicial precedent has clearly established a legal standard for a *prima facie* obviousness rejection.

The burden of establishing a *prima facie* case of obviousness falls on the Examiner. *Ex parte Wolters and Kuypers*, 214 U.S.P.Q. 735 (B.P.A.I. 1979). Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention absent some teaching or suggestion supporting the combination. *ACS Hospital Systems, Inc. v. Montefiore Hospital*, 732 F.2d 1572, 1577, 221 U.S.P.Q. 929, 933 (Fed. Cir. 1984). Accordingly, to establish a *prima facie* case, the Examiner must not only show that the combination includes all of the claimed elements, but also a convincing line of reason as to why one of ordinary skill in the art would have found the claimed invention to have been obvious in light of the teachings of the references. *Ex parte Clapp*, 227 U.S.P.Q. 972 (B.P.A.I. 1985). When prior art references require a selected combination to render obvious a subsequent invention, there must be some reason for the combination other than the hindsight gained from the invention itself, i.e., something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination. *Uniroyal Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 5 U.S.P.Q.2d 1434 (Fed. Cir. 1988).

2. **The Examiner's rejection of independent claims 1, 12 and 13 is improper because the rejection fails to establish a *prima facie* case of obviousness.**

Independent claim 1 recites:

> A winding of an electric machine comprising:
> at least one series of serially connected AC bars, each AC bar comprising:
> *a series of serially connected turns formed by litz wire having a plurality of strands*; and
> at least one cooling tube, wherein individual strands of the plurality of strands are respectively positioned substantially adjacent to the at least one cooling tube at at least one transfer point for *providing heat transfer from the respective individual strands to the at least one cooling tube.* (Emphasis added.)

Independent claim 12 recites:

> An electric machine having an AC winding comprising:
> at least one series of serially connected AC bars, each AC bar comprising:
> *a series of serially connected turns formed by litz wire having a plurality of strands*; and
> at least one cooling tube, wherein individual strands of the plurality of strands are respectively positioned substantially adjacent to the at least one cooling tube at at least one transfer point for *providing heat transfer from the respective individual strands to the at least one cooling tube.* (Emphasis added.)

Independent claim 13 recites:

> A winding of an electric machine comprising:
> at least one series of serially connected AC bars, each AC bar comprising:
> *a series of serially connected turns including at least one conductor*;
> at least one cooling tube having a cooling medium flowing through a conduit having a thermally conductive surface; and

> a phase to ground insulation for providing electrical phase to ground insulation for the AC bar, wherein the phase to ground insulation surrounds the series of serially connected turns and the at least one cooling tube;
>
> *wherein respective turns of the series of turns contact the at least one cooling tube for transferring heat from the respective turns to the at least one cooling tube*, wherein at each point of contact the phase to ground insulation does not intervene between the conductive surface of the at least one cooling tube and a respective conductor of the at least one conductor.
>
> (Emphasis added.)

3. **The references do not reasonably support a suggestion or motivation for the substitution proposed by the Examiner.**

The Examiner's position is essentially that one skilled in the art would have been motivated to replace the conductor of Emery with litz wire as discussed in Clifton. Neither of the references supports that position.

First, regarding Clifton, the Examiner relied upon the reference merely for its teachings regarding turns made of litz wire. Appellants do not deny that the reference generally discusses litz wire. Appellants also point out that litz wire, as acknowledged by the passage from the application and produced below, was clearly known prior to this invention.

> The *litz wire* forming coil 210, as known in the art, includes a plurality of individual strands 230 including lightly insulated wires wound or twisted together in a pattern, in particular embodiments a uniform pattern. The strands are transposed in a specific configuration to *reduce AC losses, as known in the art*, The multi-strand configuration minimizes power losses otherwise encountered in a solid conductor due to what are commonly known as the *"skin and proximity effects"*. *See,* Application, paragraph 25 (emphasis added).

a. **Claims 1 and 12**

However, litz wire had never been used in the manner claimed. In the particular conductor structure claimed in independent claims 1 and 12, "*providing heat transfer from the respective individual strands to the at least one cooling tube*", the heating can be minimized and additional benefits can be obtained by the use of litz wire. The references do not suggest or motivate the modification of either.

Certainly, nothing in Clifton would prompt its use in a winding of the type defined by claims 1 and 12.

Emery, on the other hand, adopts a completely different solution to a multi-conductor winding. Emery utilizes copper strands 22 in lieu of the litz wire. In Emery, increase in cooling effectiveness is provided by reducing the potential difference between the cooling tubes 30 and copper strands 22, via capacitive coupling. This multi-strand approach, then, is specifically adopted to provide capacitive coupling and thereby to reduce potential differences between the coils and the vent tubes. See, Emery, column 3, line 37 – column 4, line 14. Appellants submit that there is no reasonable basis for believing that litz wire would or even could capacitively couple in this manner. Under MPEP section 2143.01, sub-section V, it is stated that "if proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." Thus, the Examiner must demonstrate not only Emery's copper strands could be replaced by litz wire, but that there is some reasonable basis for believing it would function successfully.

Moreover, any gain in flexibility or current-carrying capacity (*e.g.*, due to skin effect) obtainable with litz wire would presumably be provided by the multiple strands taught by Emery. Thus the apparatus in Emery already reduces the eddy current losses, so there is no motivation to combine Emery with Clifton for any further reduction in the eddy current losses as taught by Clifton, since the Emery reference already performs the function.

As such, there would be no reason whatsoever for making the substitution of Clifton's litz wire in Emery's windings, except in an effort to follow the recitations of the claims.

At the very least, neither Emery nor Clifton provide any reasonable basis for the combination. According to MPEP 2143.01, *the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination.* That is not the case here. Further, under MPEP 2143.01, it is stated that there are three possible sources for a motivation to combine references: the nature of the problem to be solved, the teachings of the prior art, and the knowledge of persons of ordinary skill in the art. None of these reasons are present in case of Emery and Clifton in order to support this combination.

In summary, there is no rational reason to combine the teachings of Emery and Clifton, because one skilled in the art would not use litz wire or a series of serially connected turns instead of copper strands 22 to increase cooling effectiveness, via capacitive coupling. Furthermore, replacing copper strands 22 with litz wire may change the operation of the system disclosed in Emery, because capacitive coupling may not be achieved in such a case. Therefore, one skilled in the art would not be motivated to use the litz wire instead of copper strands 22.

Accordingly, Appellants respectfully submit that independent claims 1 and 12 and the claims depending therefrom are allowable and respectfully request the Board to reverse the rejection of the claims.

b. Claim 13

In the Office Action, the Examiner rejected claim 13 in view of Emery and Clifton. The Examiner observed that Emery does not disclose serially connected turns, but argued that Emery does provide teachings for the remainder of the recitations of claim 13. The Examiner relied on Clifton for teaching serially connected turns.

Appellants observe that, here again, there is no reasonable basis for the combination of Emery and Clifton. In particular, any such combination would essentially be counter to the reasonable interpretation and solutions taught by both references. More particularly, Emery teaches a technique for cooling a rotating machine by the use of vent tubes. Clifton, quite the contrary, teaches the reduction in heat generation in a machine by the use of flywheels.

The arrangement recited in claim 13 is intended to remove heat in two manners. As pointed out in paragraph 28 of the application, a majority of the heat transferred from the turns 211-218 occurs by way of heat flow along the individual strands 230 in a longitudinal direction. That is, heat flows along the longitudinal axis of the individual strands. Heat also is transferred from the respective individual strands 230 by formation of the cooling tubes.

Emery clearly relies only upon the vent tubes 30 for removal of heat. No mention whatsoever can be found in Emery for any other mode of heat transfer.

Clifton, on the other hand, discusses minimization of heat generation, and not heat transfer either along individual strands or from individual strands to cooling tubes. *See*, Clifton, column 11, lines 40-52.

Clearly, the references cannot be reasonably combined. That is, there would be no reasonable expectation that vent tubes of the type taught by Emery would have any purpose in the Clifton machine, where heat generation is minimized by the use of flywheels. Conversely, upon reading Emery, one skilled in the art would not be led to make the replacement of the coils of Emery with those of Clifton for heat removal purposes. Indeed, such replacement would entirely change the structure and, it is believed, would change the electrical nature of the operation of the Emery generator.

Because the teachings of Emery and Clifton cannot be reasonably combined, claim 13 is clearly allowable. That is, Emery and Clifton cannot be combined to render obvious the use of serially connected AC bars that include cooling tubes through which a cooling medium flows.

Conclusion

Appellants respectfully submit that all pending claims are in condition for allowance. However, if the Examiner or Board wishes to resolve any other issues by way of a telephone conference, the Examiner or Board is kindly invited to contact the undersigned attorney at the telephone number indicated below.

Respectfully submitted,

Date: 6/19/2006

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8. APPENDIX OF CLAIMS ON APPEAL

Listing of Claims:

1. (original) A winding of an electric machine comprising:

at least one series of serially connected AC bars, each AC bar comprising:

a series of serially connected turns formed by litz wire having a plurality of strands; and

at least one cooling tube, wherein individual strands of the plurality of strands are respectively positioned substantially adjacent to the at least one cooling tube at at least one transfer point for providing heat transfer from the respective individual strands to the at least one cooling tube.

2. (original) The winding of Claim 1, wherein heat is further transferred along the respective individual strands along the direction of a longitudinal axis of the respective individual strands.

3. (original) The winding of Claim 1, wherein a surface area of individual turns of the series of turns is positioned substantially adjacent to a respective surface area of the at least one cooling tube for establishing respective heat transfer areas, wherein each respective heat transfer area includes a plurality of transfer points.

4. (original) The winding of Claim 3, wherein each turn is positioned for establishing a respective heat transfer area.

5. (original) The winding of Claim 1, wherein the at least one cooling tube is formed of stainless steel.

6. (original) The winding of Claim 1, wherein the series of turns includes a first and second group of turns, wherein the first group of turns is substantially symmetrically arranged with respect to the second group of turns.

7. (original) The winding of Claim 6, wherein the first and second groups of turns are symmetrically arranged around the at least one cooling tube.

8. (original) The winding of Claim 3, wherein the at least one cooling tube has first and second opposing surfaces, and wherein heat transfer areas are established along the first and second opposing surfaces.

9. (original) The winding of Claim 1, wherein the series of turns is insulated with a thermally activated adhesive.

10. (original) The winding of Claim 1, wherein the series of turns is formed by winding the litz wire into a coil including the series of turns, insulating the coil with a thermally activated adhesive, shaping the coil into a predetermined shape, all at ambient temperature, and then heating the coil for curing the adhesive.

11. (original) The winding of Claim 1, wherein the series of turns is formed by winding the litz wire into a coil including the series of turns, shaping the coil into a predetermined shape, and epoxy impregnating the coil.

12. (original) An electric machine having an AC winding comprising:

at least one series of serially connected AC bars, each AC bar comprising:

a series of serially connected turns formed by litz wire having a plurality of strands; and

at least one cooling tube, wherein individual strands of the plurality of strands are respectively positioned substantially adjacent to the at least one cooling tube at at least one

transfer point for providing heat transfer from the respective individual strands to the at least one cooling tube.

13. (original) A winding of an electric machine comprising:

at least one series of serially connected AC bars, each AC bar comprising:

a series of serially connected turns including at least one conductor;

at least one cooling tube having a cooling medium flowing through a conduit having a thermally conductive surface; and

a phase to ground insulation for providing electrical phase to ground insulation for the AC bar, wherein the phase to ground insulation surrounds the series of serially connected turns and the at least one cooling tube;

wherein respective turns of the series of turns contact the at least one cooling tube for transferring heat from the respective turns to the at least one cooling tube, wherein at each point of contact the phase to ground insulation does not intervene between the conductive surface of the at least one cooling tube and a respective conductor of the at least one conductor.

14. (original) The winding of Claim 13, wherein the at least one cooling tube has a floating voltage potential.

15. (original) The winding of Claim 14, wherein the floating voltage potential is within the range of a turn-to-turn voltage of the series of turns.

16. (original) The winding of Claim 13, wherein the at least one cooling tube is electrically insulated with a film insulation of thickness not substantially greater than a minimum thickness for withstanding a maximum voltage difference between turns of the series of turns that contact the at least one cooling tube.

17. (original) The winding of Claim 13, wherein the at least one cooling tube is coated with a thermally activated adhesive.

18. (original) The winding of Claim 13, wherein at each point of contact a maximum amount of insulation intervening between the conductive surface and the at least one conductor includes at least one film insulator having a collective thickness substantially smaller than a thickness of the phase to ground insulation.

19. (original) The winding of Claim 13, wherein each turn included in the AC bar contacts the at least one cooling tube for transferring heat from the respective turn to the at least one cooling tube.

20. (original) The winding of Claim 13, wherein the at least one cooling tube has first and second opposing surfaces, and wherein turns of the series of turns contact the at least one cooling tube along the first and second opposing surfaces.

21. (withdrawn) A method of manufacturing an AC winding of an electric machine comprising the steps of:

winding a litz wire into a coil having a series of turns at ambient temperature;
insulating the coil with a thermally activated adhesive at ambient temperature;
shaping the coil into a predetermined shape at ambient temperature; and
heating the coil for curing the adhesive.

22. (withdrawn) The method of Claim 21, further comprising the step of positioning the coil for a surface area of individual turns of the series of turns to be positioned substantially adjacent to a respective surface area of at least one cooling tube for establishing respective heat transfer areas for transferring heat from the respective turns to the at least one cooling tube.

23. (withdrawn) A method of manufacturing an AC winding of an electric machine comprising the steps of:

winding a litz wire into a coil having a series of turns;

shaping the coil into a predetermined shape; and

epoxy impregnating the coil.

24. (withdrawn) The method of Claim 23, further comprising the step of positioning the coil for a surface area of individual turns of the series of turns to be positioned substantially adjacent to a respective surface area of at least one cooling tube for establishing respective heat transfer areas for transferring heat from the respective turns to the at least one cooling tube.

9. **APPENDIX OF EVIDENCE**

None.

10. APPENDIX OF RELATED PROCEEDINGS

None.